

Critical Infrastructure Inter-dependency Contingency Planning
Inter-Industry Technical Group
Electricity – Telecommunications – Natural Gas – Oil – Transportation

Preface

This document is a summary of discussions among persons from the electric power, natural gas, oil, telecommunications, and transportation industries in North America. This document is not a statement of readiness, nor is it a warranty of performance by any industry or entity. This document is not a statement of guidelines or recommendations. The purpose of the document is to simply summarize ideas related to critical infrastructure Y2k contingency planning.

Section 1 – Electric System Interdependency Strategies

The highest priority interdependency of the electric industry is voice and data communications. Although the electric industry owns and operates a majority of its communications equipment, a substantial portion is dependent on local telephone carriers, long distance carriers, satellites, cellular systems, paging systems, networking service providers, Internet service providers, and others.

Data communications provide real-time (i.e. every few seconds) updates of electric system status to SCADA systems in distribution and bulk electric control centers. Data communications are also used for remote control of devices in the field, such as circuit breakers, switches, transformer taps, and capacitors. Data communications allow generating units to follow the real-time control signals from the control center that are necessary to instantaneously balance generation to electrical demand.

It is common for data communications to be interrupted on individual channels. At any given moment in time, dozens of data channels may not be operating properly at a typical electric utility. However, if data communications are impacted on a much broader scale, operations could be impaired. Large-scale loss of data communications would not likely have an instantaneous impact on electric power production and delivery, because most devices and systems would remain in the last known position. However, after 15-20 minutes, operations could begin to become impaired, as operators would have an incomplete picture of system conditions. Electric system operations could become further impaired within an hour if load conditions are changing rapidly or within a few hours if demand is more stable. To mitigate the impact of an unlikely loss of data communications, the electric industry has been verifying and practicing alternate (voice-based) means of communicating critical information to the control centers.

The electric industry is confident there will not be widespread interruptions of data communications. However, the industry is preparing for this as a very unlikely, but critical contingency. The principal strategy is to operate using a manual transfer of a minimum set of critical information. This information is typically power flows on key transmission lines, voltages, and Interconnection (grid) frequency. Qualified field personnel at critical substations can read this information locally and convey the information to system operators in control centers.

The minimum functions required to monitor and control the transmission system and generating units may be sustained indefinitely in this manner. Some advanced applications in the control center could be impaired with a substantial loss of data, and operations are likely to be less efficient. However, essential generation and demand balancing, frequency control, and transmission security

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functions can be managed in this manner. A similar type of operation can be performed in electric distribution systems, although the focus is more on switching activities.

Voice communications are indispensable for electric system operation. Although control centers use computers to monitor and control the electric system under the supervision of a system operator, operations fundamentally require field personnel under the direction of the system operator to complete many operations. Although loss of externally provided voice systems such as telephones, cellular telephones, and pagers is considered a very unlikely event, electric systems must provide sufficient redundancy to assure continuous voice communications over a geographic area that addresses its critical facilities and interfaces to neighboring systems and regional centers.

The principal mitigation strategy is the use of microwave, long and short wave radios, satellite voice systems, privately owned phone networks, and other systems that provide independent and redundant backups. The electric industry is conducting two industry-wide drills: one was held on April 9 and the second will be held on September 8-9. One objective of these drills is to practice operating functions using only backup voice systems, in the unlikely event that data communications and primary voice systems were lost.

Electric systems also have dependencies with fuel supplies, although these dependencies do not appear as critical as those related to telecommunications. Fuel for electricity uses a diverse mix of resources (55% coal, 20% nuclear, 12% hydro, 8% natural gas, and 5% oil). Note these are national averages and fuel use will vary by region. Stockpiling coal supplies at generating stations and filling hydro reservoirs are effective strategies for assuring fuel supplies for weeks or months. Availability of nuclear facilities is an important component of assuring adequate power supply.

Natural gas and oil typically are used in a more limited way as peaking fuels when electricity demand is high (summer peaks usually, although some systems have winter peaks). With regard to Y2k, gas and oil fueled units will likely be used mostly in a reserve role as backup or quick start resources.

With diverse fuel supply options, and expected peak demands during critical Y2k periods at 50-70% of system capacity, fuel supply issues appear to be very manageable. Concerns could arise if coal, gas, or oil supply chains were disrupted for weeks or months, or if a large amount of nuclear capacity was not available for non-technical reasons associated with Y2k. An extended disruption of rail transportation impacting coal deliveries over a period of several weeks, or an exceptionally cold period in which rivers freeze (slowing barges) and coal piles freeze, could impact the fuel supply. However, electric power can be transmitted over long distances, mitigating these concerns. These concerns

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withstanding, fuel supply is expected to be manageable with planning and coordination.

It is recognized that natural gas distribution companies would have to use their tariffs for establishing priority for gas transportation in the unlikely event of a shortage. This would mean electric generation served by interruptible gas transportation would lean on other resources in that case. Retail gas deliveries are a higher priority than natural gas-fired electric generation because these facilities have alternative fuels and because of safety issues and the extensive resources required to re-light customer pilots.

Electric systems are not anticipating interruptions of service caused by Y2k, based on extensive data available from testing. Y2k anomalies are estimated to occur in 2-3% of devices and the anomalies are predominantly cosmetic, affecting date displays in event recorders and logs. Y2k does not appear to impact the primary functions related to production and delivery of electricity. Y2k can effect metering, accounting, billing and other date sensitive systems, however, these systems are being tested and repaired.

Because there is no physical damage anticipated by Y2k, such as the damage that could be caused by a severe storm, icing, or an earthquake, restoration times would be expected to be brief, in the unlikely event of power outages. With increased staffing in critical facilities, restoration time should be further decreased. Most typical restoration times for partial outages (some circuits lost but most generation and load remains intact) historically have been shown to be in minutes or a few hours at most.

Restoration strategies on the bulk electric system are driven by a specific sequence of operations designed to reenergize and reconnect the backbone transmission system as quickly as possible. These procedures are driven mostly by physical constraints of the system. Restoration of distribution systems can focus on reestablishing service to priority customers, such as hospitals and other critical care facilities. Each distribution system typically has an established list of critical customers. Although this list does not specifically address telecommunications, gas, or oil systems in most cases, discussions with the electricity service providers may be appropriate to coordinate priorities.

Electrical systems are impacted on an everyday basis by weather, damage to power poles or lines, and transformer, or cable failures. Test results to date indicate that risks associated with Y2k are not any worse than these day-to-day risks. Electricity users, including those from telecommunications, natural gas, and oil industries should consider their own exposures to loss of electrical power supply in terms of historical performance of their service provider. Y2k does not appear to have a worse impact on electrical systems than weather, earthquakes, equipment failures, or other everyday type occurrences.

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More information about Y2k in electric utilities may be found at the following web sites:

<http://www.nerc.com/y2k/>

<http://year2000.epriweb.com/>

<http://www.eei.org/EEI/press/y2k/members.htm>

<http://www.nusmg.org/>

Section 2 – Telecommunications Systems Inter-dependency Strategies

The key external dependency for telecommunications systems is electric power. The primary mitigation strategy is to use existing primary and backup power supplies. Most critical communications facilities are protected by uninterruptible power supplies or batteries. Typical backup battery supplies will last 6-8 hours. Additionally, key facilities have backup generators that can supply power for sustained periods. In some cases, the generators (the largest is on the order of 2 MW) can be moved from one site to another as needed, but would be expected to be located in the most critical sites, such as sites with network facilities, through Y2k periods.

Telecommunications providers intend to operate for the most part in a normal configuration for power supplies and respond to contingencies on an exception basis. Generally, fuel supplies will be topped off; key facilities may have increased staffing to respond to contingencies.

One possible vulnerability is power supply to signal regeneration sites, since these sites can be in remote locations. This concern is being addressed by the use of batteries. A limited number of portable generators are often available to power these sites during sustained loss of power.

Fuel supplies impact telecommunications from the perspective of maintaining diesel supplies for generators and gasoline for the fleet of service vehicles.

Coordination with electric providers on critical facilities may be advised. Some local meetings have already taken place to establish communications priorities for electric service and electric system priorities for communications circuits.

Key web sites to obtain further information on telecommunications Y2K readiness and contingency plans include:

<http://www.nric.org>

<http://www.telcoyear2000.org>

<http://www.itu.int/y2k>

<http://www.atis.org>

Section 3 – Oil and Natural Gas Interdependency Strategies

Production as well as transportation of crude oil and natural gas are closely related and have many operating similarities. In the oil and gas industry, safety of personnel and protection of the environment are primary considerations in design and implementation of industry operating systems.

Production Operations

Production operations are reliant on power and telecommunications for both ongoing operations as well as when dealing with operational interruptions or failures. Key aspects of operations with reliance on electrical power include:

- Artificial lift systems,
- Pumps
- Gauging and metering
- Monitoring and *control* devices
- Emergency and shut-down systems
- Habitation facilities
- Communication systems

These critical systems are backed-up by emergency power generators fueled by diesel, fuel oil, or natural gas and in some instances, batteries. Additionally, key systems such as those used for safety shut-down or environmental control quite often have manual or pneumatic back-up or redundant systems. Short to intermediate interruptions in power availability from conventional sources can be well tolerated in most production operations. Some operations could, however, be impacted by extended power outages.

In some operations, in addition to the production of oil and gas, electric power for use within the operation is also produced. These types of operations, by virtue of their independence from public power grids, may be less vulnerable to interruptions and failures than those that are fully reliant on power being provided by the utilities.

Operations personnel throughout industry are updating and exercising contingency plan preparations for potential interruptions in power supply by storing additional back-up fuel supplies and batteries, validating the reliability of back-up generators, and refreshing operating personnel knowledge of procedures for use of back-up and redundant systems.

Telecommunication capabilities are also important, particularly over the long-term, for some production operations. Information to efficiently monitor and control operations is conveyed through various telecommunication systems. For short to intermediate periods, absence of this information will not necessarily

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interrupt operations. Over extended periods, this information can be acquired through manual means in many operations. Some operations, however, could be interrupted in the event of extended telecommunication failures.

Back-up communication methods such as cell or satellite phones and two-way radios are routinely available in production operations to ensure continued voice communication capability in the event of interruption in conventional telecommunication systems.

Pipeline and Distribution Systems

The two highest priority dependencies of oil and natural gas pipeline and distribution systems are electric power supply and telecommunications. Electric power supply is addressed first, followed by telecommunications.

In most areas, compressor engines are self-sufficient for natural gas systems, in that they use natural gas from the systems to drive the compressors. Although the applications are limited, some natural gas systems employ electric-driven compressors. Crude oil pipelines rely on pumps to move crude efficiently between facilities or to market. These pumps can rely on electrical power or self generated power. These pumps However, essential generation and demand balancing, frequency control, and transmission security functions can be managed in this manner. A similar type of operation can be performed in electric distribution systems, although the focus is more on switching activities. are typically designed with redundant power and pumping capabilities.

Natural gas and crude oil pipeline and distribution systems have natural gas or diesel fueled backup generators to provide power for critical compressor or pumping auxiliary and control systems in the event of electric power loss. Some of the backup generators are designed to activate automatically in the event of a power loss, but others must be put on-line manually.

As a part of their contingency planning many companies will be staffed at their critical locations in order to bring their backup generation on-line if electric power is lost. To manage staffing loads, many of these same companies are also considering starting their available backup generators several hours prior to key Y2k dates and running the generators through the critical periods. Since the amounts of electricity are small compared to overall electric system load, this strategy would have little impact on electric systems. However, compression and pumping stations that would impose a significant electrical load and that plan to use this strategy will notify their local power providers. For those applications employing generators not fueled by natural gas, topping off the backup generator fuel tanks is obviously one other aspect of this mitigation plan.

Meter stations at delivery and receipt points and interconnects with other pipelines that are equipped with electronic flow measurement (EFM) devices have back-up power supplies that will sustain normal operations for extended periods if power is lost. However, even if power is lost for metering, crude oil and natural gas flow will not be impacted as manual control procedures will be initiated as outlined below. Metering stations without EFM are not impacted by loss of power

Natural Gas systems have an advantage of having a natural gas inventory packed in the delivery system under pressure. Therefore, loss of electric power does not result in an instantaneous interruption of flow. Rather, natural gas continues to flow under the pressure built up in the pipe. With the combination of natural gas in the pipe, storage facilities, gas-driven compressors, and backup generators, it is expected that many natural gas systems could continue to deliver gas indefinitely even under conditions of loss of electric power. There may be a reduced rate of delivery in the locations where electric driven compressors are the source of primary compression.

Many crude oil and natural gas facilities are located in remote areas, and areas that experience severe weather conditions, i.e., ice storms and blizzards. The companies therefore have substantial experience with maintaining deliveries during electrical outages and other adverse circumstances.

The loss of electric power can also affect the ability to run facilities and computer systems for system monitoring, dispatch of personnel, metering and billing, customer services and other essential business functions. Most major computer systems are backed up by both uninterruptible power systems and standby generation. However, these systems generally operate at a reduced level and are not necessarily designed for indefinite operation.

Data communication is also an important element of crude oil and natural gas system operations. For a short-term interruption of data transmission, crude oil and natural gas system operations would continue with the "last known data." At the time of interruption, manual data acquisition and transmission would be initiated using voice communications. Thus, interruption of automated data communications does not pose an immediate risk to delivery. If the data communications interruption is for a longer period (i.e., 12 hours or longer) and crude or gas loads changed significantly, delivery systems could be impacted somewhat by the slower response time created by the manual versus automated data transmission.

Crude oil and natural gas operations are also dependent on voice communications. Without voice communications, operations, particularly implementation of contingency plans such as manual operations, could be impaired and degrade over a period of hours as significant changes occur in the

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system. To mitigate this concern, a variety of public and private phone systems, cellular phones, pagers, microwave, and radio systems are used for redundancy. For Y2K, the backup voice systems are primarily microwave, satellite and short and long wave radios. Most operators routinely utilize several communications centers using this equipment and expect to be able to contact field locations during any primary or secondary -system communication loss.

Crude oil and natural gas companies will be reviewing geographic coverage of radios and microwave systems, testing performance and ensuring that personnel are trained in the proper use of these systems. This will ensure availability in the unlikely event of a loss of primary voice systems. Because some of these backup systems (microwave, radios) are commonly used in daily operations, testing and training will not require significant additional activity beyond what is normally scheduled for these systems.

In summary, crude oil and natural gas systems are generally well equipped with gas-driven compressors and gas or diesel fired pumping facilities and backup generators to be able to continue natural gas and crude oil deliveries following an interruption of electric power supply. It is anticipated that crude oil and natural gas deliveries could continue to flow for a period of time – days, should power be unexpectedly lost. Failure of primary communications would predominately impact scheduling, automated control data transfer, and accounting information, but would not interrupt deliveries. Crude oil and natural gas operations are equipped with redundant voice communication systems which can be manual operated in the event that primary communication systems are lost.

Refining

Refining operations can be impacted similarly to production operations in the event of power or telecommunications interruptions. Refineries are reliant on telecommunications systems for transfer of monitoring and control information and power generation for ongoing manufacturing processes. Additionally, cell phones and two-way radios are widely available as back-up voice communication options in refining operations in the event of conventional telecommunication failures.

Most refineries however, have cogeneration and/or back-up power supplies (including uninterruptible power supplies) to address the loss of offsite power. As in production operations, additional fuel and battery supplies are being stored in the event of longer than typical electrical outages.

International Operations

The interdependencies outlined for the oil and gas industry occur in international as well as domestic operations. In some international operating environments,

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reliability of infrastructure services is lower than that normally experienced in U. S. operating environments. International operations routinely deal with interruptions in power and telecommunication supply and are not only well prepared to deal with them but are also accustomed dealing with these types of interruptions as part of the international operating environment.

The following internet site provide further information related to natural gas and oil industries and Y2k:

www.ferc.fed.us/y2k/

www.aga.org/y2k/

www.api.org/y2k/

www.ingaa.org/

Section 4 – Common Issues

All of the critical infrastructure industries indicate a vulnerability to customer behavior due to misinformation about Y2k. Electric systems prefer customer activities be as close to normal for the New Year holiday weekend as possible. Excessive voice traffic could have an effect on communications that are essential to each of the critical infrastructure industries. Each of the industries depends on essential supplies and services, such as gas and diesel for vehicles and backup generators, water, and other supplies.

A common strategy of the critical infrastructure industries is to provide accurate and reliable information to the public regarding the real impacts of Y2k so that the public can understand that Y2k does not pose extraordinary risks to critical infrastructure beyond the risks posed by everyday events.